29. (New) The method of claim 28, wherein the metal composite of the substrate is titanium nitride, tungsten nitride, and nickel-phosphorus.

30. (New) The method of claim 18, wherein the pH of the polishing composition is about 6 or less.

31. (New) The method of claim 30, wherein the pH of the polishing composition is about 5 or less.

## REMARKS

The Pending Claims

Claims 1 and 17-31 are currently pending. Claims 1 and 17-31 are directed to a method of polishing a substrate comprising the use of a composition comprising a metal oxide abrasive and a liquid carrier, wherein the composition has a pH of about 7 or less and the metal oxide abrasive has a total surface hydroxyl group density no greater than about 3 hydroxyl groups per $nm^2$. Reconsideration of the pending claims is respectfully requested.

Correction of Inventorship

Thorough review of the application and the circumstances prior to its filing (e.g., the conception and reduction to practice of the claimed invention) has revealed an error in inventorship. Pursuant to 37 C.F.R. § 1.48(a), applicant respectfully requests that inventorship be corrected to also name Gautam Grover as a joint inventor. The documents required by 37 C.F.R. § 1.48(a) attached hereto are:

- A petition from Gautam Grover, including a statement that the error in inventorship occurred without deceptive intention (Appendix A);
- A Combined Declaration and Power of Attorney as required by 37 C.F.R. § 1.63 executed by all three of the co-applicants (Appendix B);
- A check in the amount of $130.00 to cover the amount specified by 37 C.F.R. § 1.17(i); and
- Written consent of the assignee, Cabot Microelectronics Corporation (Appendix C).

Amendments to the Claims

Claims 2-16 have been canceled and rewritten as claims 17-31. New claims 17-21 correspond to original claims 10-14. New claims 22-29 correspond to original claims 2-9. New claims 30 and 31 correspond to original claims 15 and 16. New claim 17 is dependent

on claim 1. New claim 18 is dependent on claim 17. New claims 19-31 are dependent, directly or indirectly, on claim 18.

No new matter has been added by way of any of these amendments. The precise amendments to the claims, as well as the pending claims as amended, are set forth on separate attachments hereto.

Summary of the Office Action

Claims 1-16 stand rejected under 35 U.S.C. § 103(a) as obvious over Adams (i.e., U.S. Patent 5,664,990) and Kaneko (i.e., U.S. Patent 5,114,881).

Rejection of Claims 1-16 Under Section 103(a)

The final Office Action alleges that claims 1-16, now claims 1 and 17-31, are obvious under Section 103(a) in view of the combined disclosures of Adams and Kaneko. In particular, the Office Action relies on Adams for its disclosure of a method of polishing a substrate having a metal layer with a composition comprising a metal oxide abrasive and a liquid carrier, wherein the composition has a pH of about 5 or less, but recognizes that Adams does not disclose a metal oxide abrasive having a "total surface hydroxyl group density" no greater than about 3 hydroxyl groups per $nm^2$. The Office Action relies on Kaneko for its recitation of a metal oxide (i.e., silica) having 0.1 to 4 hydroxyl groups. Despite the fact that Kaneko does not teach or suggest a method of polishing a substrate and does not disclose a polishing composition, the Office Action alleges that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the disclosure of Adams by using the metal oxide of Kaneko so as to arrive at the present invention.

> To establish a prima facie case of obviousness, three basic criteria must be met: (a) there must be some suggestion of motivation to modify the reference or to combine reference teachings; (b) there must be a reasonable expectation of success; and (c) the prior art references must teach or suggest all the claim limitations. M.P.E.P. § 2142

(a) There Is No Suggestion Or Motivation To Combine The Cited References

The Section 103(a) rejection is improper because there is no suggestion or motivation to combine the references in such a way as to arrive at the claimed subject matter. In order to set forth a *prima facie* case of obviousness based on a combination of references under Section 103(a), the Office Action must identify a "clear and particular" teaching, suggestion, or motivation to combine the references. *In re Demiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999), *abrogated on other grounds* by *In re Gartside*, 203 F.3d 1305, 1316, 53 U.S.P.Q. 2d 1769, 1769-1770 (Fed. Cir. 2000); *In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998); *Uniroyal,*

*Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1051 (Fed. Cir. 1988). As the Federal Circuit has stated, "combining prior art references without evidence of such a suggestion, teaching or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability – the essence of hindsight." *In re Demiczak*, 175 F.2d at 999.

In support of the Section 103(a) rejection, the Office Action alleges that it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to apply the metal oxide of Kaneko to Adams "because the use of fine silica with a low total surface hydroxyl group density helps prevent cracking and fractures, which is extremely desirable in the art" (page 3 of the Office Action). Such a statement of "motivation" to combine the cited references is at best unclear, and at worst completely erroneous, and reflects a fundamental misunderstanding or misconstruence of the disclosures of the cited references.

Kaneko discloses the use of fine silica having 0.2 to 4 hydroxyl groups/$nm^2$ as a preferred starting material in a method of producing ceramics. Kaneko teaches that by using such a fine silica starting material, the ceramic materials formed therefrom will have fewer fractures and cracks. In particular, Kaneko teaches a method of producing ceramic materials involving combining the fine silica with an alkoxysilane reagent and optionally a binder to form a mixture, wherein the alkoxysilane reagent is deposited on the surface of the fine silica and the fine silica is partially agglomerated. The silica/alkoxysilane mixture is then molded (e.g., by pressing, extrusion, or injection molding) into a shape such as pellets, strands, or sheets. The "preform" thus obtained is then heated so as to promote a de-alcoholysis of the alkoxysilane with the silica. In such a de-alcoholysis reaction, the hydroxyl groups on the surface of the silica react with the alkoxysilane for form a siloxane (Si-O-Si) bond. After de-hydrolysis, the ceramic preform is sintered to convert the mixture into a ceramic material, for example, an optical glass, a belljar, a crucible, or a semiconductor product. The ceramic material disclosed by Kaneko contains less water and therefore, the ceramic product has a lower occurrence of fracturing and/or cracking. Kaneko does not even remotely teach or suggest the use of the fine silica in a method of polishing a substrate. In fact, there is *absolutely nothing* in Kaneko that suggests that the fine silica, which is taught for use in a process of producing ceramic products, could be used *in any other field*, and especially a method of polishing a substrate such as the method recited in the pending claims.

Similarly, there is nothing in Adams that suggests the combination of the cited references. Adams discloses a method of recycling polishing slurry during chemical-mechanical polishing of semiconductor substrates. Adams describes many different polishing compositions for various types of semiconductor substrates in the background section of the patent. None of the polishing compositions disclosed by Adams contains a metal oxide having a surface hydroxyl group density of no greater than about 3 hydroxyl

groups per $nm^2$, as recited in the pending claims. In fact, nowhere in the disclosure of Adams is there any suggestion that the surface hydroxyl group density of the abrasive is even important. Moreover, nothing in Adams suggests that suitable polishing compositions might include metal oxides that are known as useful starting materials for preparing ceramic materials.

The technologies disclosed by Kaneko and Adams, in particular the method of producing ceramic materials and the method of chemical-mechanical polishing, clearly are patentably distinct. As discussed above, there is nothing in either reference to support their combination. Indeed, the only connection between the cited references seems to be the fact that Adams discloses polishing compositions for use in polishing various substrates and Kaneko discloses the keywords "silica" and "hydroxyl group density." Absent any suggestions in the references themselves to combine their disclosures, an ordinarily skilled artisan given Adams as a guide, would not be lead to the disclosure of Kaneko as alleged by the Office Action.

The motivation for combining the cited references, as stated in the Office Action, is that "the use of fine silica with a low total surface hydroxyl group density helps prevent cracking and fractures, which is extremely desirable in the art." It is unclear from this statement which "art" the Office Action refers to. While Applicants agree that the use of fine silica with a low total surface hydroxyl group density helps prevent cracking and fractures *in ceramic products* formed using the fine silica (as taught by Kaneko), Applicants do not consider such a statement to set forth a motivation for combining the cited references. The statement in the Office Action seems to erroneously imply that the disclosures of Adams and/or Kaneko suggest that it is desirable in the patentably distinct art of chemical-mechanical polishing to prevent cracking and fractures - - despite the fact that Adams does not teach or even remotely suggest a desire to reduce cracking or fracturing of anything, let alone something to do with chemical-mechanical polishing, and Kaneko does not remotely suggest that the fine silica could reduce cracking or fracturing in anything besides ceramic products. Indeed, since the silica in chemical-mechanical polishing is not itself formed into anything, there is no analogous silica product to even prevent the cracking and fracture of in the context of the chemical-mechanical polishing disclosed by Adams. In view of the forgoing, the statement of "motivation" set forth in the Office Action for the alleged combination has no basis of support in the cited references and is entirely unfounded.

Given that the disclosure of Adams lacks any guidance regarding the type of metal oxide to be used in a method of polishing a substrate, and given that the disclosure of Kaneko lacks any suggestion that the silica starting material used for producing ceramics could be

used in a method of polishing, one of ordinary skill in the art would not be motivated to combine the cited references, except with the improper hindsight of the present invention.

(b) There Is No Reasonable Expectation of Success

Even if the ordinarily skilled artisan were provided with the combination of Adams and Kaneko, there would have been no reasonable expectation of success that the use of a fine silica having 0.2 to 4 hydroxyl groups per $nm^2$ would be advantageous in a method of polishing a substrate. As discussed above, neither Adams nor Kaneko teaches or suggests that the use of a metal oxide having a low hydroxyl group density in a method of polishing is desirable, or even possible. In the absence of such a teaching or suggestion, the ordinarily skilled artisan would not have had a reasonable expectation that the combination of the teachings of the cited references would result in a successful method of polishing a substrate comprising a metal, metal oxide, metal composite, or mixture thereof.

(c) The Cited References Do Not Teach or Suggest All the Claim Limitations

The cited references, either alone or in combination, fail to teach or suggest all the elements of the invention as recited in the pending claims. In particular, the cited references do not disclose a method of polishing a substrate comprising the use of a metal oxide having a surface hydroxyl group density of no greater than about 3 hydroxyl groups per $nm^2$. Adams does not even remotely recognize the importance of surface hydroxyl group density of the metal oxide abrasive, let alone disclose that a hydroxyl group density of no greater than about 3 is desirable. Kaneko discloses a fine silica ceramic starting material having 0.1 to 8 hydroxyl groups/$nm^2$, preferably 0.2 to 4 hydroxyl groups/$nm^2$. Although Kaneko discloses a broad range of hydroxyl group density for the metal oxide ceramic starting material, Kaneko does not recognize the particular benefits of a surface hydroxyl group density of no greater than about 3 hydroxyl groups/$nm^2$. Thus, even if Adams and Kaneko are combined, the present invention, as defined by the pending claims, does not necessarily result.

For the foregoing reasons, the Patent Office has not made out a prima facie obviousness rejection. The Patent Office has not shown a clear and particular suggestion or motivation in the prior art to combine the disclosures of the cited references, let alone that such a combination would necessarily result in the claimed invention, which would be reasonably expected by one of ordinary skill in the art to function successfully. Accordingly, the Section 103(a) rejection is improper and should be withdrawn as to all the pending claims.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

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Date: August 26, 2002

**CERTIFICATE OF MAILING**

I hereby certify that this RESPONSE TO OFFICE ACTION (along with any documents referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, Washington, D.C. 20231.

Date: August 26, 2002

**RESPONSE UNDER 37 CFR 1.116**
**EXPEDITED PROCEDURE**
**EXAMINING GROUP 1765**

**PATENT**
Attorney Docket No. 207617

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:

Dirksen et al.

Application No. 09/737,905

Filed: December 15, 2000

For: METHOD OF POLISHING OR PLANARIZING A SUBSTRATE

Art Unit: 1765

Examiner: V. Perez-Ramos

**AMENDMENTS TO CLAIMS**
**MADE IN RESPONSE TO OFFICE ACTION DATED JUNE 25, 2002**

2. canceled

3. canceled

4. canceled

5. canceled

6. canceled

7. canceled

8. canceled

9. canceled

10. canceled

11. canceled

12. canceled

13. canceled

14. canceled

15. canceled

16. canceled

17. (New) The method of claim 1, wherein the metal oxide abrasive is selected from the group consisting of alumina, silica, titania, ceria, zirconia, germania, magnesia, and combinations thereof.

18. (New) The method of claim 17, wherein the metal oxide abrasive is silica.

19. (New) The method of claim 18, wherein the metal oxide abrasive is fumed silica.

20. (New) The method of claim 18, wherein the total surface hydroxyl group density is no greater than about 2.8 hydroxyl groups per $nm^2$.

21. (New) The method of claim 20, wherein the total surface hydroxyl group density is no greater than about 2.5 hydroxyl groups per $nm^2$.

22. (New) The method of claim 18, wherein the substrate comprises a metal.

23. (New) The method of claim 22, wherein the metal of the substrate is selected from the group consisting of copper, aluminum, titanium, tungsten, gold, platinum, iridium, ruthenium, and combinations thereof.

24. (New) The method of claim 23, wherein the metal of the substrate is tungsten.

25. (New) The method of claim 18, wherein the substrate comprises a metal oxide.

26. (New) The method of claim 25, wherein the metal oxide of the substrate is selected from the group consisting of alumina, silica, titania, ceria, zirconia, germania, magnesia, and combinations thereof.

27. (New) The method of claim 26, wherein the metal oxide of the substrate is silica.

28. (New) The method of claim 18, wherein the substrate comprises a metal composite.

29. (New) The method of claim 28, wherein the metal composite of the substrate is titanium nitride, tungsten nitride, and nickel-phosphorus.

30. (New) The method of claim 18, wherein the pH of the polishing composition is about 6 or less.

31. (New) The method of claim 30, wherein the pH of the polishing composition is about 5 or less.


**RESPONSE UNDER 37 CFR 1.116**
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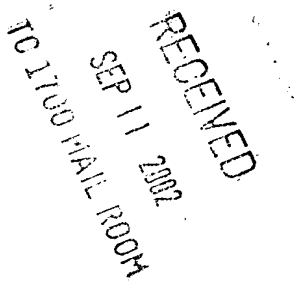


**PENDING CLAIMS AFTER AMENDMENTS**
**MADE IN RESPONSE TO OFFICE ACTION DATED JUNE 25, 2002**

1. A method of polishing or planarizing a substrate comprising abrading at least a portion of the surface of a substrate comprising a metal, metal oxide, metal composite, or mixture thereof, with a composition comprising a metal oxide abrasive and a liquid carrier, wherein the composition has a pH of about 7 or less and the metal oxide abrasive has a total surface hydroxyl group density no greater than about 3 hydroxyl groups per $nm^2$.

17. The method of claim 1, wherein the metal oxide abrasive is selected from the group consisting of alumina, silica, titania, ceria, zirconia, germania, magnesia, and combinations thereof.

18. The method of claim 17, wherein the metal oxide abrasive is silica.

19. The method of claim 18, wherein the metal oxide abrasive is fumed silica.

20. The method of claim 18, wherein the total surface hydroxyl group density is no greater than about 2.8 hydroxyl groups per $nm^2$.

21. The method of claim 20, wherein the total surface hydroxyl group density is no greater than about 2.5 hydroxyl groups per $nm^2$.

22. The method of claim 18, wherein the substrate comprises a metal.

23. The method of claim 22, wherein the metal of the substrate is selected from the group consisting of copper, aluminum, titanium, tungsten, gold, platinum, iridium, ruthenium, and combinations thereof.

24. The method of claim 23, wherein the metal of the substrate is tungsten.

25. The method of claim 18, wherein the substrate comprises a metal oxide.

26. The method of claim 25, wherein the metal oxide of the substrate is selected from the group consisting of alumina, silica, titania, ceria, zirconia, germania, magnesia, and combinations thereof.

27. The method of claim 26, wherein the metal oxide of the substrate is silica.

28. The method of claim 18, wherein the substrate comprises a metal composite.

29. The method of claim 28, wherein the metal composite of the substrate is titanium nitride, tungsten nitride, and nickel-phosphorus.

30. The method of claim 18, wherein the pH of the polishing composition is about 6 or less.

31. The method of claim 30, wherein the pH of the polishing composition is about 5 or less.